

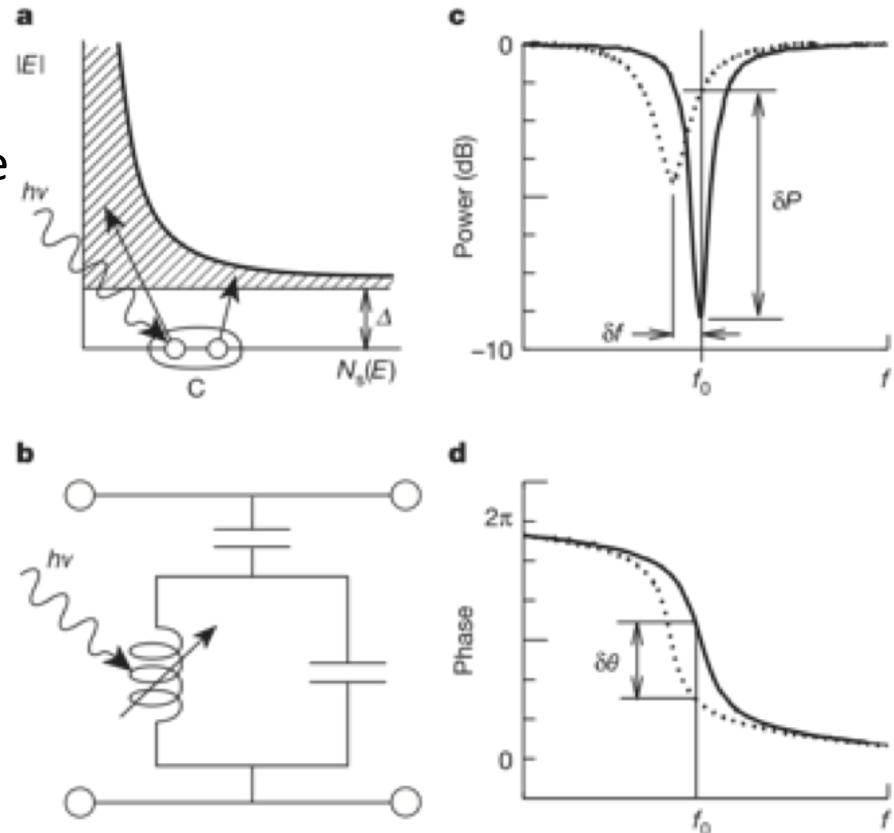
MKIDs

Andrei & Anze

7 Oct 2014

Kinetic Inductance Detectors (1)

- Absorption of photon produce quasi-particles changing supercurrent hence effective inductance of superconductor
- This changes frequency and phase of the resonator
- Used now for detection of microwave radiation but can be used for optical photons as well

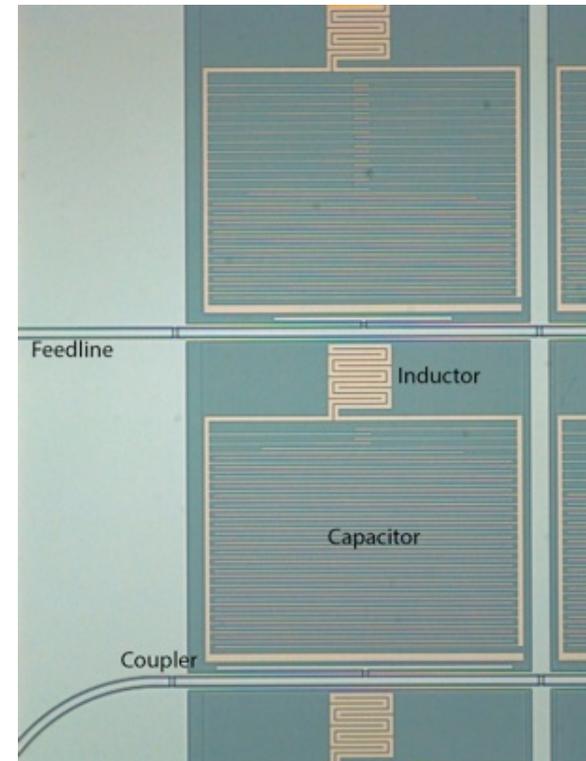


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Kinetic Inductance Detectors (2)

- Cryogenic superconductive detectors, work at 100mK, energy gap ~ 10 meV
- Can be pixelated on 100 micron pitch using planar technologies
 - 60 nm thick TiN film
- Could provide energy resolution for 0.1-10 eV photons
- Theoretically can have $L/dL \sim 100$

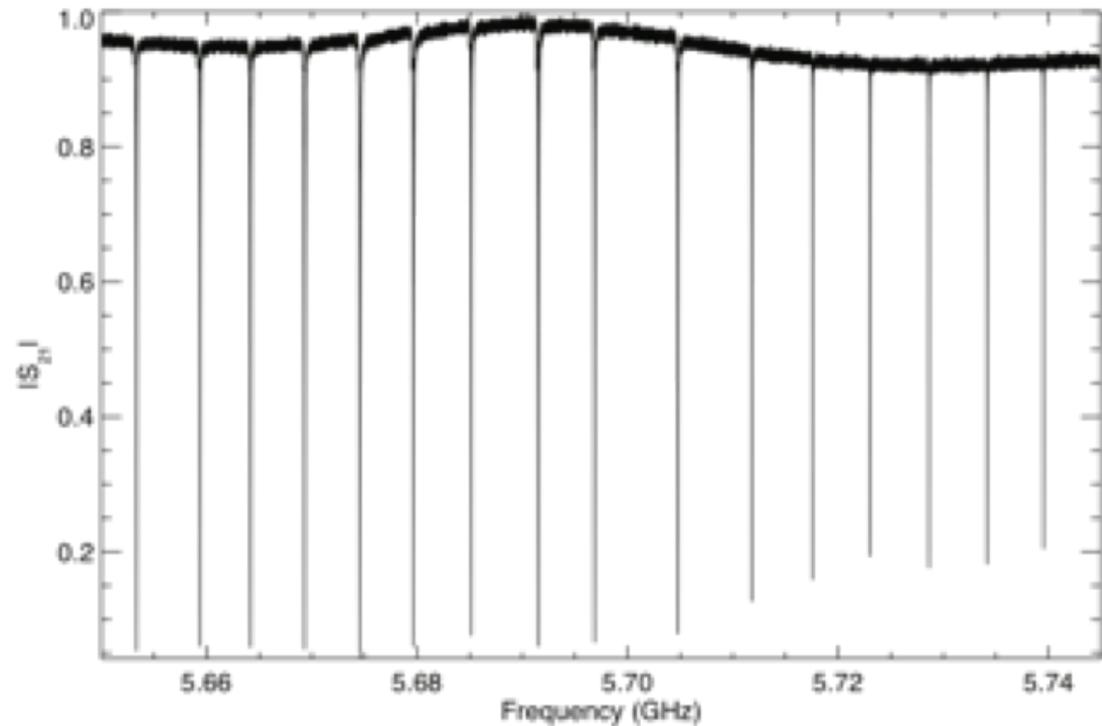
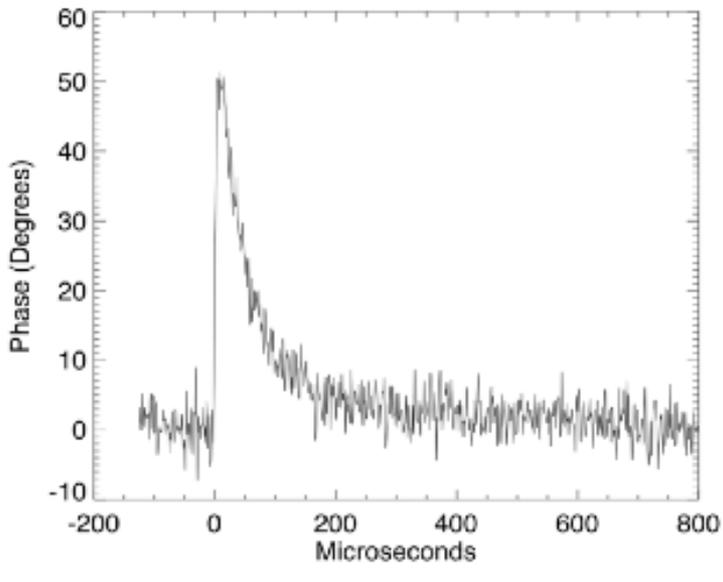
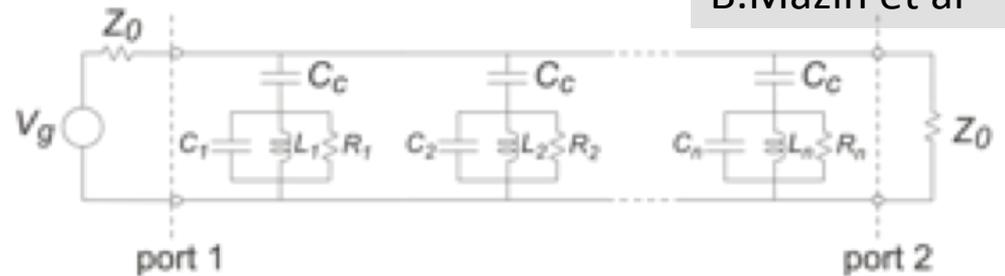
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Kinetic Inductance Detectors (3)

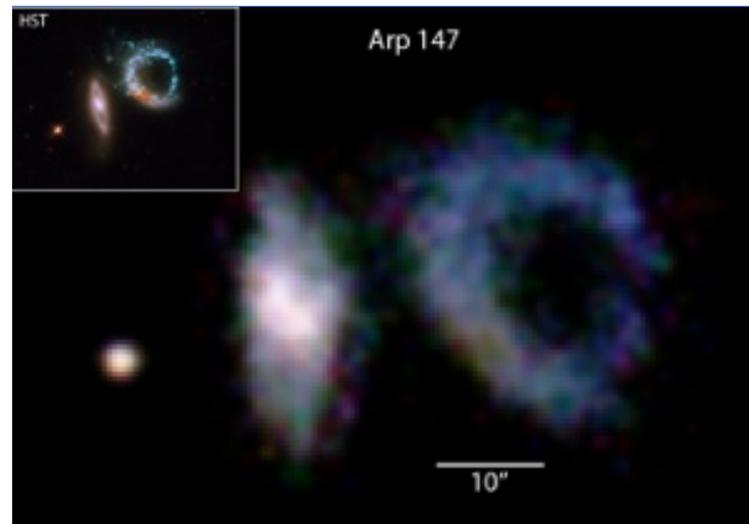
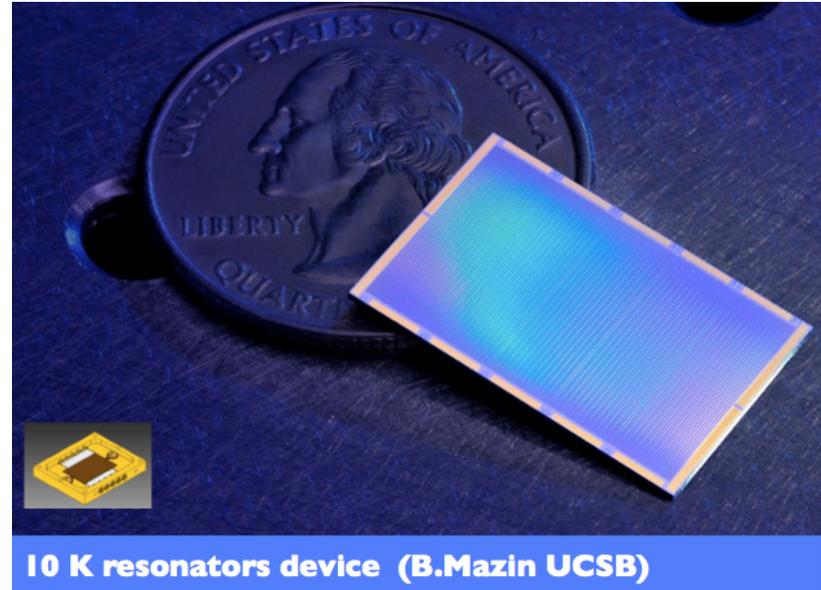
- Can be multiplexed in frequency domain
- $\sim \mu\text{sec}$ timing resolution
 - Below: one 254 nm photon

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Optical MKIDs for astronomy

- Real devices
- First data
- Collaboration:
UCSB, SOAR
telescope, Oxford,
Argonne, Fermilab



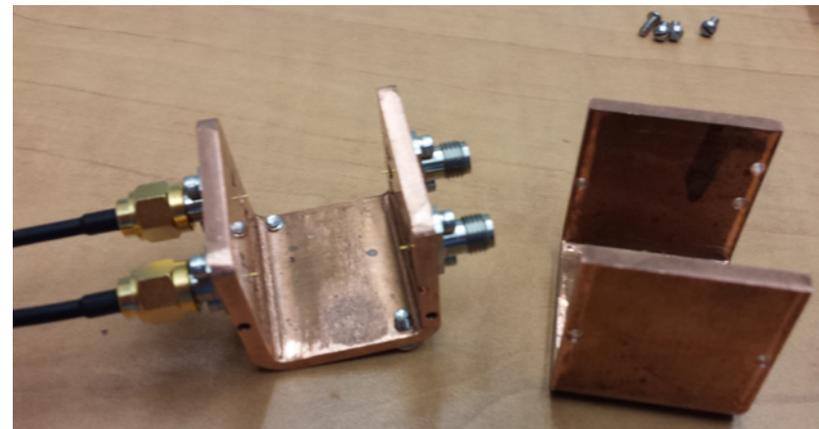
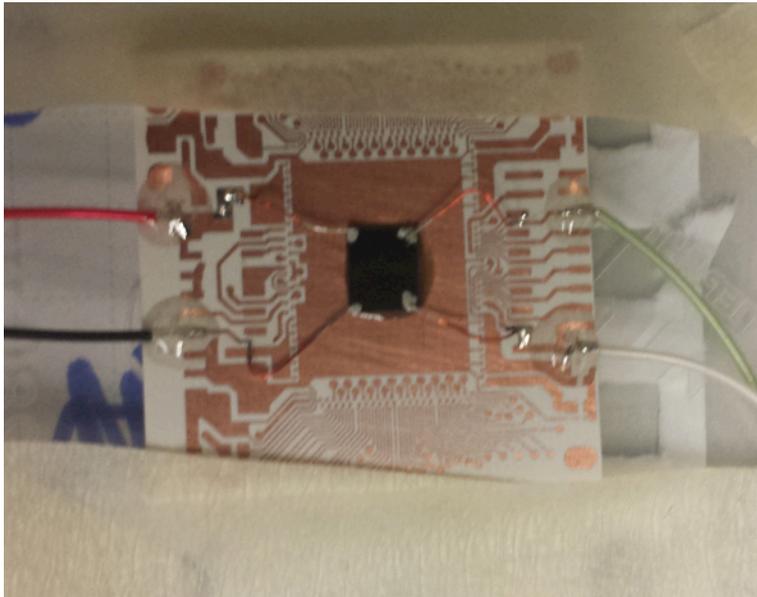
Motivation

- Spectroscopic follow up for surveys (LSST)
- Failures in z are big issue – big bias for w . this is more important than precise z determination.
- MKIDs allow for huge samples with low failure rate

HTS MKID

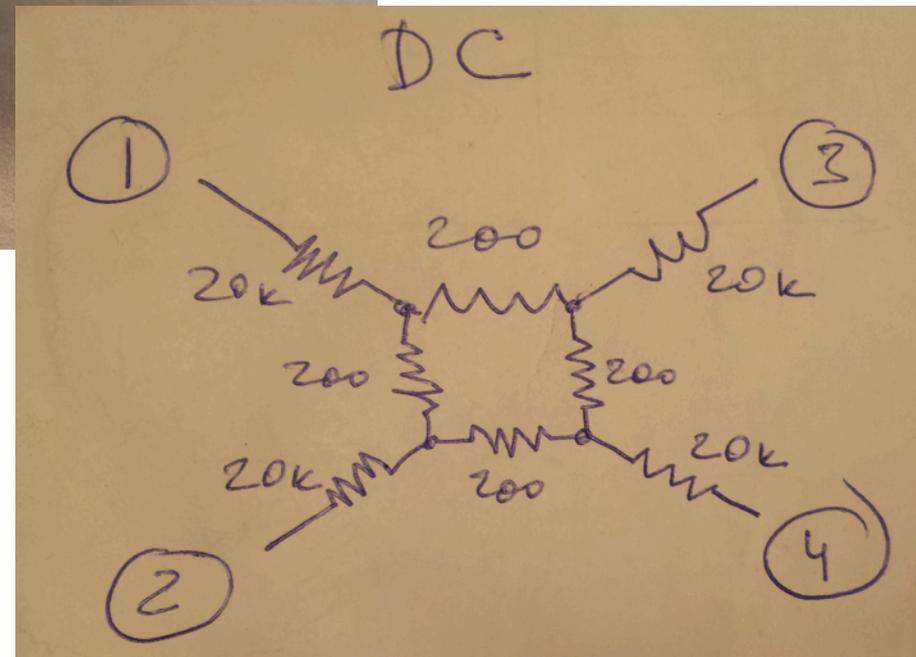
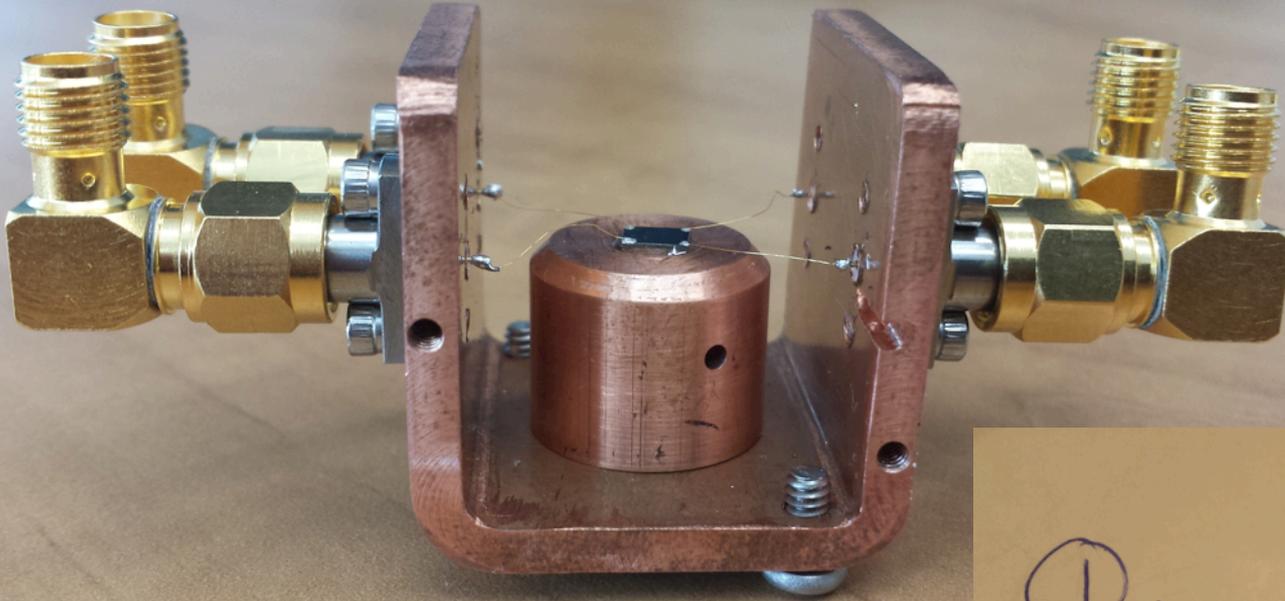
- Pros: 77 K instead of 0.1 K
- Cons: not clear if this would work at all

- Have a HTS sample (YBCO) from Materials and a room in Physics
- Initial assembly in Instrumentation
- RF box in Physics, help from Materials and NSLS-2



• Sept 2014

RF box



Impedance: 29 Sept 2014 (3)

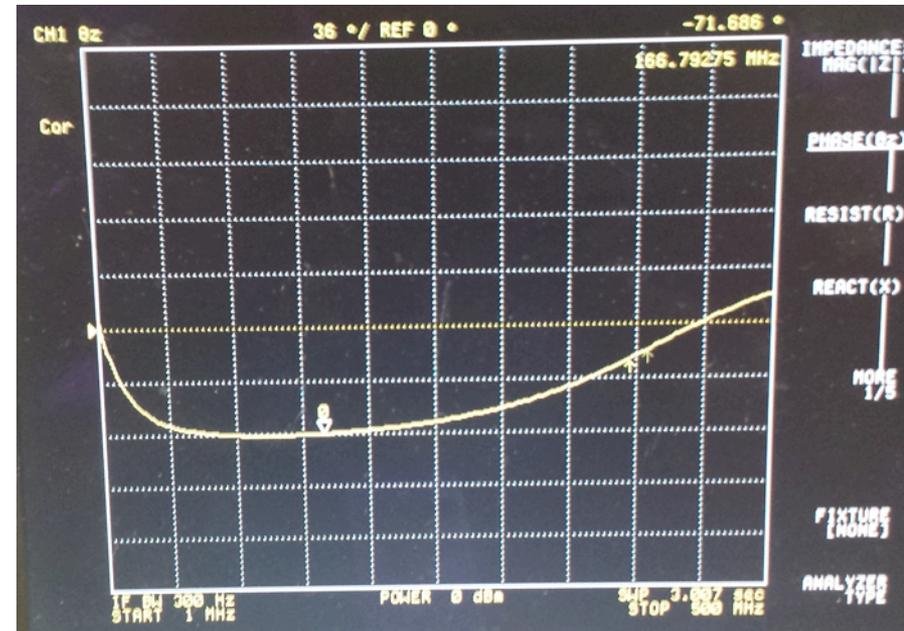
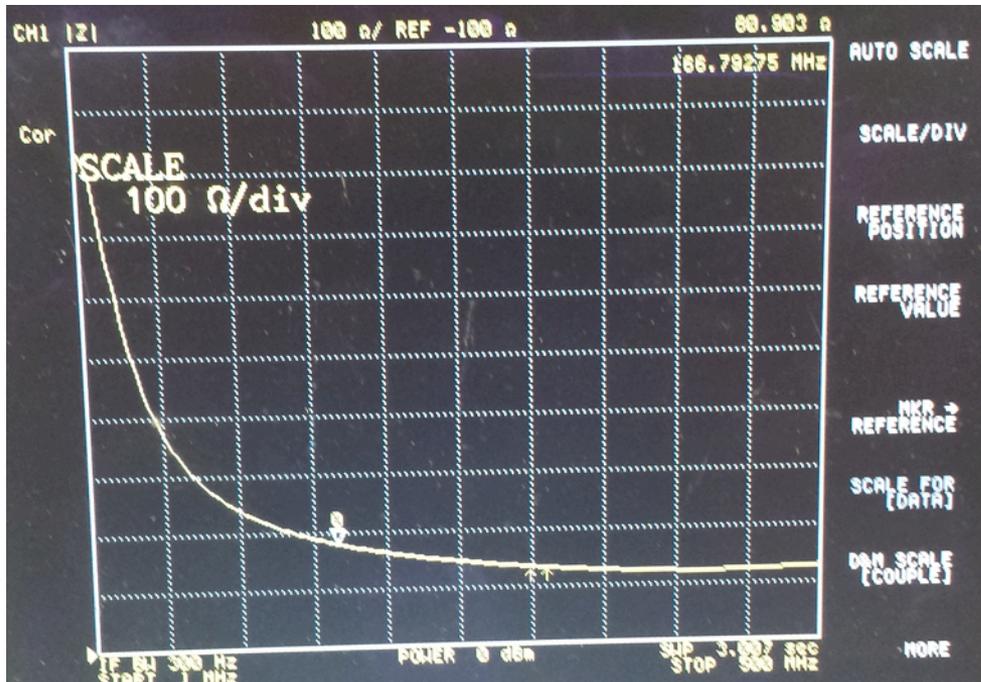
SMA 4 shorted with 50 Ohm to ground (RF box)

SMA 3 impedance (between central wire and ground):

20 Ohm @ 500 MHz

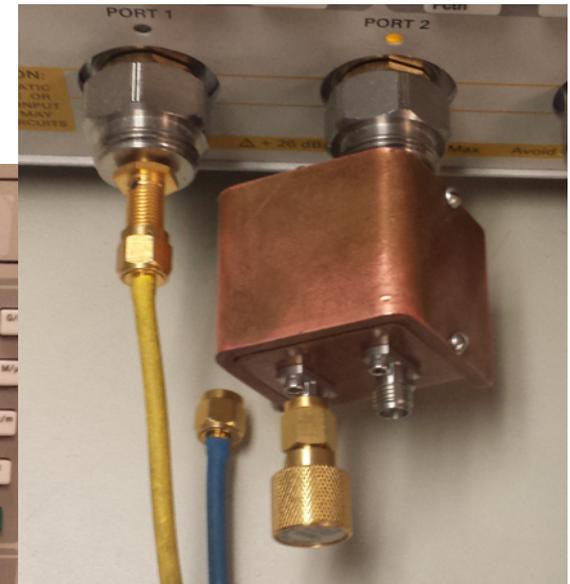
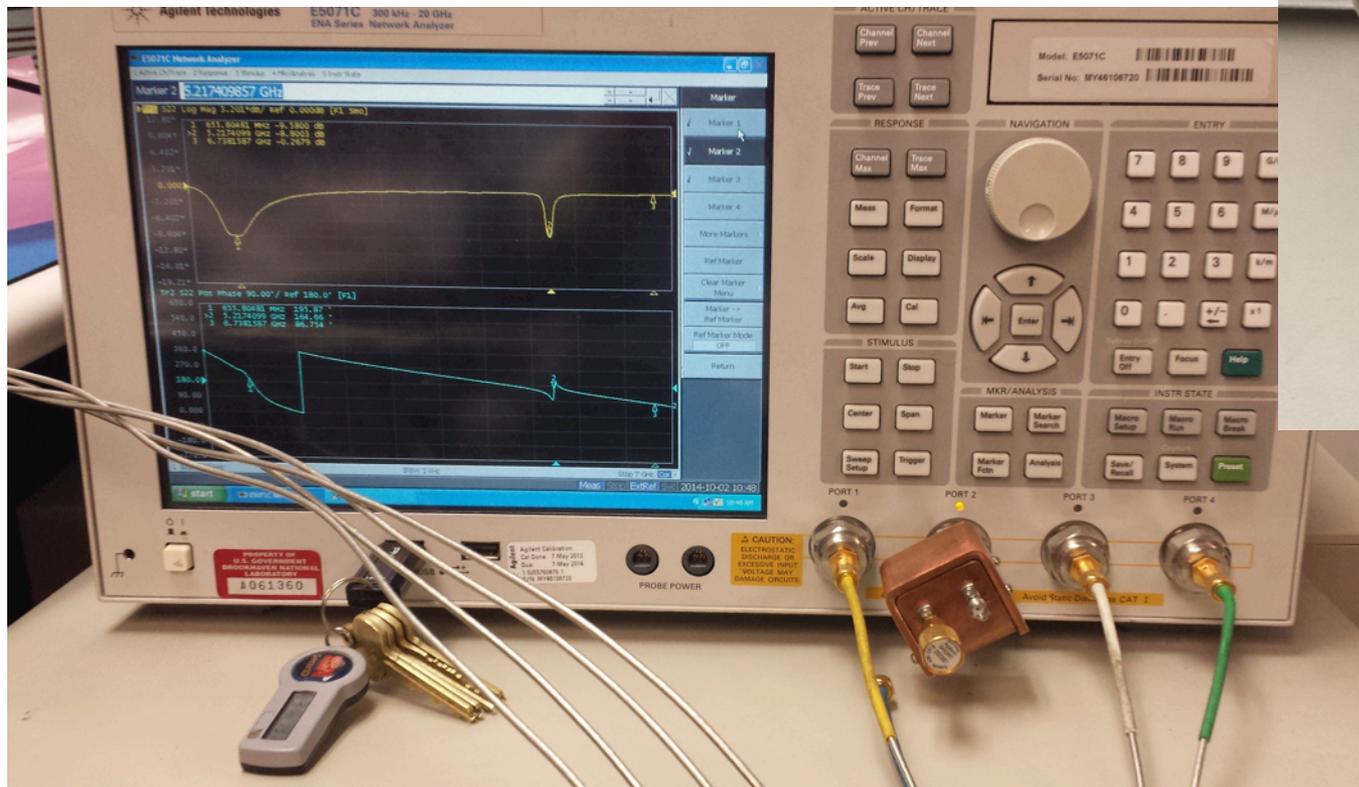
750 Ohm @ 5 MHz

Phase = 0 @ 450 MHz – resonance?



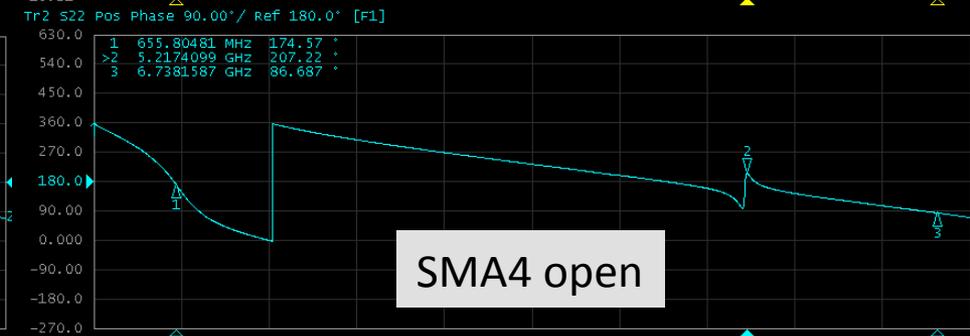
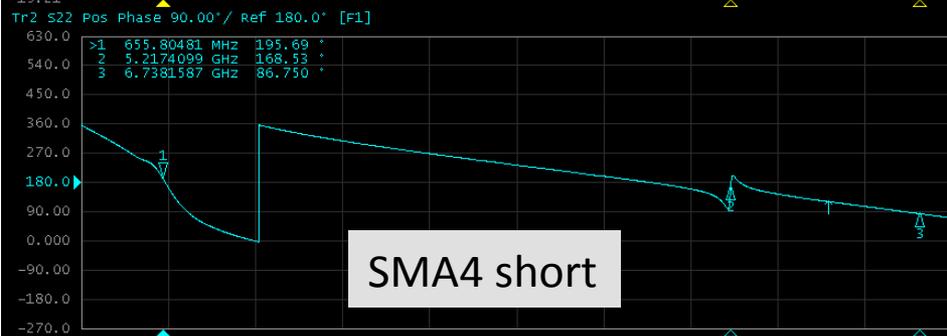
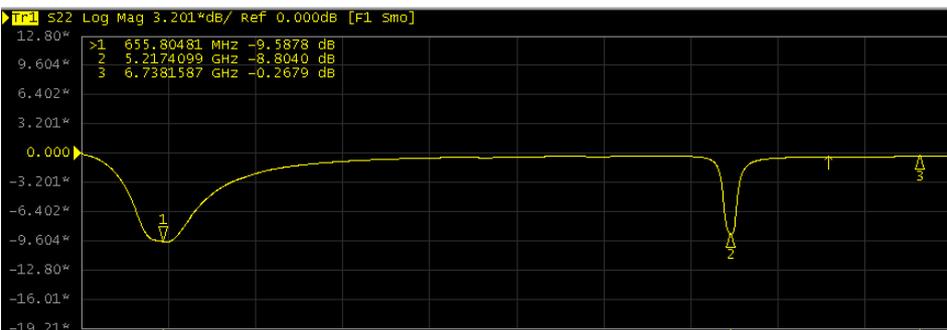
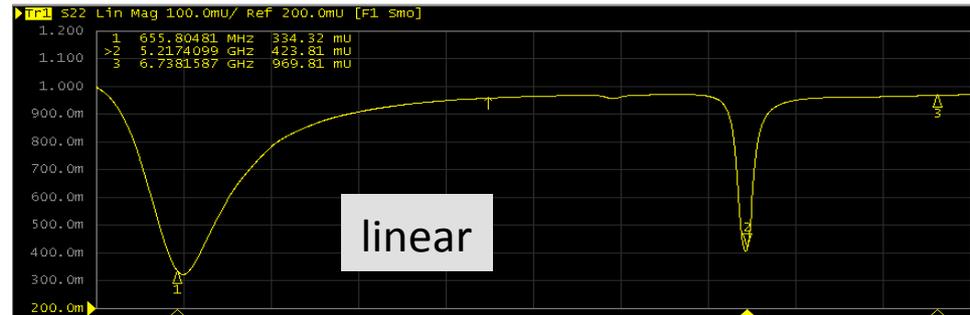
10/2/2014: Agilent E5071C Network Analyser (300 kHz – 20 GHz)

- Lab 175 in bld 745 (NSLS-II)



10/4/2014

- Measure transmission(?) log mag (S22) (top) and phase (bottom) for SMA1
- Short & open in SMA4
- Resonances at 670 MHz and 5.2 GHz

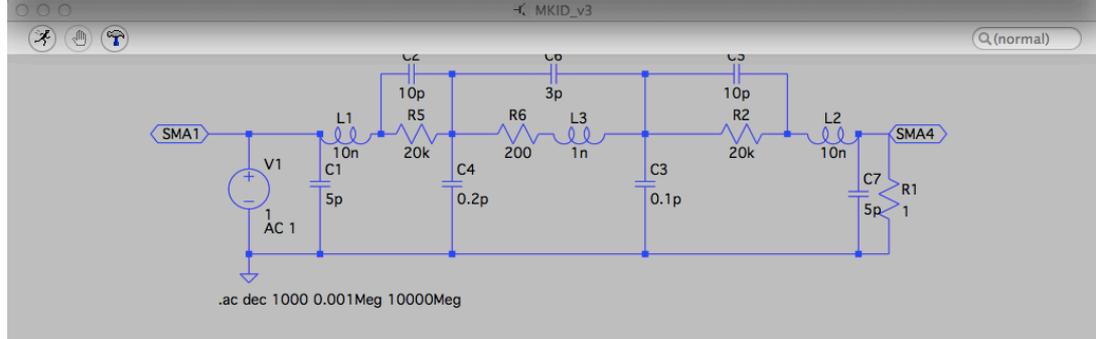
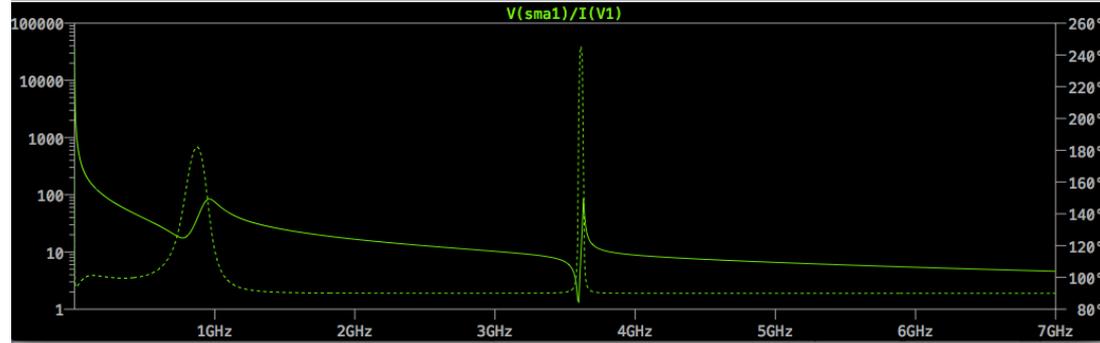
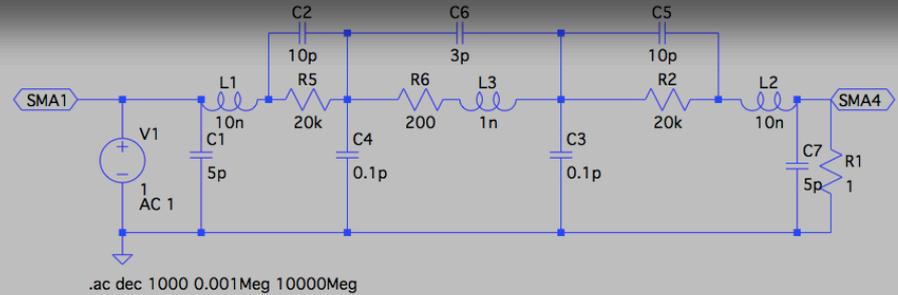
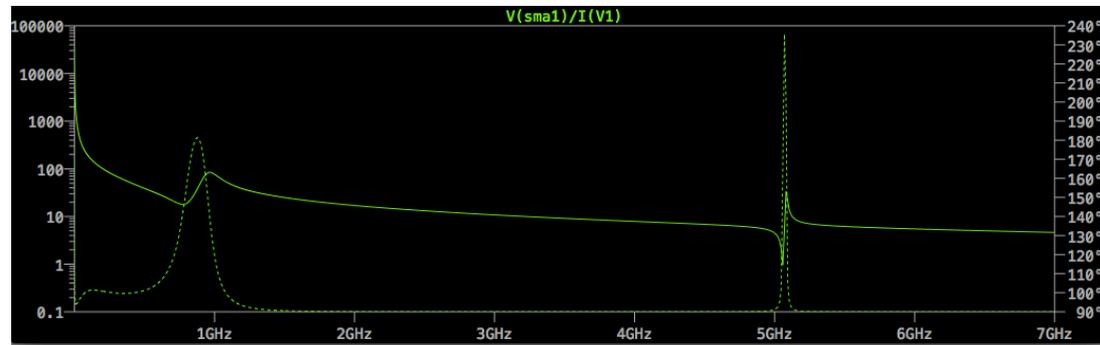
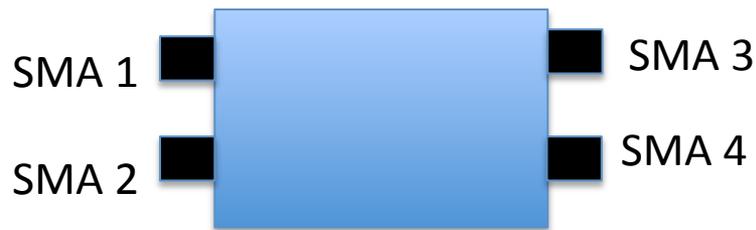


10/2/2014

SPICE again..

- More tweaking to make it similar to the measurement
- Second resonance is sensitive to C4 and C3, see plots
- It's also sensitive to L1 and L2 but not to L3
- So it looks that so far we are measuring smth which has little to do with the sample

hmm..



plans

- Short-term plan: see SC transition, learn how to pattern and metalize the sample and do proper wire-bond connections, see SC kinetic inductance, talk to other astronomy MKID types (Mazin, Estrada)
- Mid-term plan: have results, write a proposal